UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/007,708	11/13/2001	Robert A. Jacobsen	APTI:062	9924

7590 07/09/2004

ROSSI & ASSOCIATES
P.O. Box 826
Ashburn, VA 20146-0826

EXAMINER	
ROGERS, DAVID A	
ART UNIT	PAPER NUMBER
2856	

DATE MAILED: 07/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Applicati n No.	Applicant(s)	
	10/007,708	JACOBSEN ET AL.	
	Examiner	**Art Unit**	
	David A. Rogers	2856	

-- The MAILING DATE of this communicati n appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _18 May 2004_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1,4,5 and 13-20_ is/are pending in the application.

4a) Of the above claim(s) _13-18_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1,4,5,19 and 20_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _13 March 2003_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1 and 5 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,318,254 to Shaw *et al.* in view of U.S. Patent Application Publication 20030043964 to Sorenson and United States Patent 6,378,387 to Froom. KRC 7/7/04

Shaw teaches a remotely controlled aircraft maintenance robot (reference item 20), as best seen in figures 1 and 2. The complete system of Shaw *et al.* also comprises a control station (reference item 156) to control the aircraft maintenance robot, as best seen in figures 9 and 10. Shaw *et al.* teaches that the maintenance robot comprises an antenna (reference item 72) for communicating with the control station in a wireless manner. The control station comprises an antenna (reference item 158) for communicating in a wireless manner with the maintenance robot (column 6, lines 4-12 and column 6, lines 58-61). The maintenance robot comprises a mast (reference item 26) and an articulating arm (reference items 36 and 38), where the inner arm (reference item 38) is connected to the mast via a trunion (reference item 40).

Shaw further teaches a propulsion system for the main chassis (column 3, lines 61-66).

In use the inner arm is raised and lowered as required and as seen in figure 1. By the raising and lowering of the inner arm the device of Shaw *et al.* is capable of positioning the outer arm, and its distal end in particular, in an accurate manner. Shaw *et al.* further teaches that a camera (reference item 76) mounted near the end of the outer arm (reference item 36) may be an infrared camera, a thermographic sensor, an ultrasonic sensor, video camera, or any appropriate sensor or viewing device (column 4, lines 10-13). Ultrasonic sensors are well known in the art as being capable of nondestructive inspection of structures as in the instant application. Shaw *et al.* also teaches that an additional probe (reference item 230) may be installed in the manifold (reference item 44) located at the end of the outer arm (reference item 36). This additional probe may be one that allows the inspection of the aircraft surfaces using X-rays (column 7, lines 63-68). X-rays are also well known in the art as being capable of nondestructive inspection of structures, as in the instant application. Shaw *et al.*, however, does not teach a vehicle with low profile main chassis for maneuvering under portions of a structure and a mast fixed and extendable perpendicular to the main chassis.

Sorenson teaches a large structure inspection device comprising a mobile main chassis, a mast that is fixed and extendable perpendicular to the chassis, and an articulating arm connected to the upper end of the extendable mast.

Furthermore, the device of Sorenson comprises non-destructive inspection means located at the distal end of the articulating arm. The extendable mast of Sorenson and the movable arm member of Shaw perform the same function of accurately positioning the articulating arm, and the inspection head in particular. Finally, as can be seen in figure 1, the main chassis is relatively small and would be capable of maneuvering under a structure. This would be highly desired in the case of Shaw *et al.* as it would allow even greater flexibility in locating the inspection head in hard-to-access regions of the structure.

With regard to claim 19, Shaw *et al.* and Sorenson disclose mobile devices for inspecting large structures. Sorenson, as best seen in figure 1, teaches that the height of the main chassis of the inspection device is quite small relative to the large structure being inspected. Based on figure 1, the main chassis (reference item 20) appears to have a total height of about 1.78 meters assuming the operator (reference item 80) is about 5.8 feet tall. This height would allow for the main chassis to maneuver under some structures, particularly in the case of large aircraft. Furthermore, Sorenson teaches a second inspection apparatus with a second chassis (reference item 30) that is significantly smaller than the first chassis. The smaller size of the second chassis would clearly allow it to maneuver under, or even within, large structures.

Shaw *et al.* also teaches

> "...the maintenance tools are coupled may be positioned in response to control signals; and a processor which, after accounting for the position of the aircraft, the weather conditions, ands the physical dimensions of the aircraft, generates the control signals used to position the maintenance tool such that, after positioning the aircraft, the maintenance operation may be performed without human intervention." (Abstract)

> "This arrangement allows the maintenance tool to follow the surfaces of the aircraft in close proximity such that the aircraft may be washed, inspected by video, depainted, or deiced depending on the particular maintenance tool coupled to the free end of the plurality of arms, without substantial intervention of a human operator." (column 2, lines 8-14)

and

> "The operator in the operations center 156 enters the tail number or a dimensional code on the control panel 194 with second keyboard 210. The information is transmitted to the aircraft maintenance robots 20, and their first processors 100 retrieve the proper envelope for that specific aircraft; the envelope is an imaginary covering for the commercial aircraft 222 of a given thickness such that, if the robotic arm traces out the envelope, it will remain within a given distance of the aircraft surfaces." (column 8, lines 13-22)

Clearly, Shaw *et al.* teaches that the vehicle is program with a three dimensional space within which the arm of the robot is to operate.

Likewise, Sorenson teaches

> "In an embodiment, a programmed inspection sequence directs data collection positioning for automated coverage of the structure." (Abstract)

> "In accordance with an aspect of the present invention, the inspection devices are automatically moved to each portion of the structure to be inspected according to an inspection sequence that controls the movement of the inspection devices along the structure. In an embodiment, the inspection sequence is a programmed inspection sequence. The programmed inspection sequence that controls movement of the inspection devices along the structure may be produced at some time prior to the inspection by an operator moving one or both of the inspection devices through data collection positions and programming the data collection positions into the inspection sequence." (page 1, § 0007)

> "In an embodiment, the programmed inspection sequence that controls movement of the inspection devices along the structure is produced from surface data generated from visual surveying equipment. In another embodiment, the programmed inspection sequence is produced from surface model data derived from Computer Assisted Design (CAD) data." (page 1, § 0008)

Sorenson also clearly teaches the use of three dimensional mapping (CAD is known to be a 3-D mapping tool) for the inspection system.

Shaw *et al.* and Sorenson, however, does not teach the use of "control data based on a three dimensional model of a space in which the remote

controlled robotic vehicle is to operate and the structure is located." Froom teaches an automated aircraft inspection system. In particular, Froom teaches

> A method for design of a non-destructive inspection, testing and evaluation system for aircraft and components having a precision robotic system is provided. The dimensional and structural requirements of a building are determined, and a preliminary design for the building is made. (column 13, lines 44-47)
>
> The dimensional, structural, and functional requirements for robots to be housed within the building are determined, and a preliminary design of the robots is made. (column 13, lines 56-58)
>
> The dimensional, structural, and functional requirements of any end effectors mounted on the robots are determined, and a preliminary design of the end effectors is made. (column 13, lines 66-67 and column 14, line 1)
>
> When the preliminary designs of the buildings, robots, and end effectors are completed, modeling of the entire system may be performed to assure accuracy and repeatability of robot positioning. (column 14, lines 21-24)
>
> An NDI, NDT or NDE system or process having the characteristics of the present invention preferably contains the steps to perform the method for the non-destructive inspection and testing of aircraft intact or components including a database comprising at least one profile of a prototypical aircraft or component (a comparison standard), maintaining an enclosure at constant environmental conditions as to temperature, humidity, pressure, etc., and placing at least one aircraft or component into the enclosure for comparison with the standard. (column 14, lines 33-42).
>
> A "gold body" database (i.e., a standard) is established for each configuration of aircraft such as the Boeing 727, 737 or 757. Also the length and height of the aircraft may vary and is identified by model and series such as the Boeing 737-100 or 737-400. Each model and series aircraft is located to a specific spot for the nose gear and main landing gear tires centerline and lined on the floor. Other production inspection aircraft of the same model and series will also use the line on the floor for rough positioning. The aircraft is then jacked into position using jacks 205 (FIG. 3) taking the load off of the tires and actuators. Thus, the aircraft becomes fixed in position and can no longer move due to tire pressure changing because of environmental changes or loss of hydraulic pressure in the actuators. Vision edges 210 (FIGS. 2 and 3), with two straight metal edges, 90 degrees to each other are attached to the aircraft's wing tips; horizontal stabilizer, outer leading edges and/or to other parts of the aircraft. The location of these vision edges are checked against the standard for initializing the system and to identify the type and model of aircraft to be inspected and also detect gross distortion and torsion of the airframe to be inspected. Thus, the vision edges define reference markers. (column 14, lines 43-64)

and

> Once the whole aircraft has been taught to the system of the present invention, the scan plans of each NDI method can be applied in part or whole on follow-on aircraft to be inspected (production aircraft). Production aircraft are not absolutely required to be jacked in place for stabilization. The aircraft is located within the facility to the line

> markings on the floor plus or minus eight inches. The robot then seeks to locate the vision edges on the aircraft. Once located, the robot automatically recognizes where the taught aircraft was in reference and where follow-on production aircraft is located. This is called an offset and is transparent to the system operators. (column 15, lines 25-35)

Clearly, Froom teaches the control of an inspection apparatus in three dimension space in which the vehicle is to operate. Doing the same for the apparatus of Shaw *et al.* would allow for more autonomous operations and repeatable operations of the inspection vehicle.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Shaw *et al.* with the teachings of Sorenson and Froom to obtain an robotic inspection vehicle comprising a extendable mast fixed to a main chassis and an articulating arm attached to the fixed mast, where the chassis is small to allow maneuvering under a structure, in order to allow the inspection device greater positioning flexibility for inspecting regions that might otherwise prove difficult to access; and where the apparatus is program with a three dimensional space in which it will operate.

3. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shaw *et al.* in view of Sorenson and Froom as applied to claim 1 above, and further in view of U.S. Patent 5,633,707 to Seemann.

With regard to claim 4 it is widely known that propulsion systems, including gas turbine engines, comprise at least one battery. Therefore, the apparatus of Shaw *et al.* would anticipate claim 4 when interpreting the claim in its broadest, most reasonable manner. Shaw teaches that gas turbine propulsion system is preferred, however other similarly compatible forms of

locomotion are considered (column 3, lines 63-66). Replacing a gas turbine engines, as used in the device of Shaw *et al.*, with an all-electric propulsion system would be within the scope of one of ordinary skill. An example of converting from gas turbine to electric motor propulsion can be found in the automotive industry.

Even if it was not within the scope of one of ordinary skill, Seemann teaches a robotic aircraft inspection apparatus comprising an inspection vehicle, as best seen in figures 1 and 2. Seemann teaches that the nondestructive inspection apparatus comprises an electric motor (reference item 24) to drive the vehicle (column 4, lines 22-31). It is widely known that vehicles powered by electric motors typically have at least one battery. Furthermore, one would be motivated to utilize an electric propulsion system in lieu of a gas turbine, as in the device of Shaw *et al.*, in order to reduce and/or eliminate the amount of hazardous exhaust fumes that exist, especially if the inspection of the large structure was to occur within the confines of a closed environment such as an aircraft hanger.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Shaw *et al.*, Sorenson, and Foom with the teachings of Seemann to obtain a nondestructive inspection apparatus comprising a vehicle with an electric propulsion system comprising at least one battery.

4. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shaw *et al.* in view of Sorenson and Froom as applied to claim 1 above, and further in view of U.S. Patent Application Publication 20030048081 to Seeman.

Shaw *et al.* in view of Sorenson and Froom teaches mobile inspection device for inspecting large structures. Shaw *et al.* utilizes motor-driven two tracks (reference item 30 and 32) for moving the device. Sorenson utilizes four wheels for maneuvering the device. Neither Shaw *et al.* nor Sorenson teaches the use of motor driven wheels and a castor wheel arranged in a triangular manner.

Seemann teaches a mobile inspection device for inspecting structures. As best seen in figure 1, the inspection device comprises a triangular arrangement of wheels. There are two motor-driven wheels (reference item 76 and 80) and a castor wheel (reference item 72) and are mounted to provide three points of support for the base (page 5, paragraph 42). Additional wheels (reference items 84 and 88) are optional (page 5, paragraph 43).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Shaw in view of Sorenson with the teachings of Seemann to obtain an inspection apparatus comprising three wheels forming a triangular base that supports the main chassis and where two of the wheels are motor-driven and one wheel is a castor wheel in order to allow maneuvering of the main chassis by a remote operator and to allow a greater

degree of flexibility in the maneuvering that the castor wheel provides so that the device can be positioned to inspect areas that might otherwise be inaccessible.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Rogers whose telephone number is (571) 272-2205. The examiner can normally be reached on Monday - Friday (0730 - 1600).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hezron E. Williams can be reached on (571) 272-2208. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

dar
06 July 2004

HELEN KWOK
PRIMARY EXAMINER
Helen Kwok